

WE CLAIM AS OUR INVENTION

- 1 1) A microprobe device for providing a signal to an external
2 analyte meter indicating analyte presence in an analyte-containing
3 bodily fluid of a subject, comprising:
4
5 a silicon substrate having an X length dimension and a Y width
6 dimension and a Z thickness dimension, and having an front side and a
7 back side extending in the X and Y dimensions;
8
9 a body portion formed by the silicon substrate;
10
11 a microprobe portion formed by the silicon substrate, having a
12 body end connected to the body portion, and having a penetration end
13 extending away from the body portion in the X length dimension for
14 penetrating into the subject to access the fluids; and
15
16 biosensor integrated into the silicon substrate, for sensing
17 analyte presence and for providing a signal in response to the
18 analyte presence.
- 1 2) The device of Claim 1, wherein the microprobe portion is
2 width tapered along the X length dimension, converging from a larger
3 Y width dimension at the body end to a smaller Y width dimension at
4 the penetration end.
- 1 3) The device of Claim 2, wherein the convergence of the
2 microprobe taper is uniform establishing a constant change in the Y
3 width dimension.
- 1 4) The device of Claim 2, wherein the convergence of the
2 microprobe taper is nonuniform establishing a continuous change in
3 the Y width dimension for optimizing stress distribution during
4 penetration.

1 5) The device of Claim 1, wherein the Y width of the microprobe
2 portion is about 200 micrometers at the body end and about 30
3 micrometers at the penetration end.

1 6) The device of Claim 1, wherein the X length of the
2 microprobe portion is from about mm to about 2.5 mm.

1 7) The device of Claim 1, wherein the microprobe portion has a
2 penetration depth of from about 0.5 mm to about 2 mm.

1 8) The device of Claim 1, wherein the X length of the body
2 portion is from about 0.3 mm to about 2 mm, and the Y width of the
3 body portion is from about 0.3 mm to about 2 mm.

1 9) The device of Claim 1, wherein the Y width dimension of the
2 microprobe portion terminates in a chisel shaped point at the
3 penetration end.

1 10) The device of Claim 1, wherein the Y width dimension of the
2 microprobe portion terminates in a symmetrically shaped point at the
3 penetration end.

1 11) The device of Claim 1, further comprising a silicon
2 microfillet portion at the connection between the body end of the
3 microprobe portion and the body portion.

1 12) The device of Claim 1, further comprising signal interface
2 structure integrated into the silicon substrate on the body portion
3 thereof for interfacing with the analyte meter; and signal carrier
4 integrated into the silicon substrate between biosensor and interface
5 structure for carrying the signal.

1 13) The device of Claim 12, wherein the biosensor is an
2 electrobiosensor, the signal is carried by electrical energy, the
3 signal carrier is a pair of electrically conductive leads, and the
4 interface structure is a pair of electrically conductive contacts.

1 14) The device of Claim 13, wherein the biosensor is an
2 electrochemical biosensor responsive to the analyte presence by
3 altering the electrical energy of the signal.

1 15) The device of Claim 14, wherein the alteration in the
2 electrical energy of the signal is proportional to the concentration
3 of the analyte presence.

1 16) The device of Claim 13, wherein the biosensor is an
2 oscillating electrogravimetric biosensor responsive to the analyte
3 presence by altering oscillation frequency.

1 17) The device of Claim 16, wherein the alteration in the
2 oscillation frequency indicates the concentration of the analyte
3 presence.

1 18) The device of Claim 13, further comprising an electrically
2 insulative layer on the silicon substrate.

1 19) The device of Claim 18, wherein the insulative layer is a
2 silicon oxide film.

1 20) The device of Claim 18, wherein the biosensor is deposited
2 on the insulative layer.

1 21) The device of Claim 18, wherein the conductive leads and
2 the conductive contacts are conductive metal deposited on the
3 insulative layer.

1 22) The device of Claim 18, wherein the conductive leads and
2 conductive contacts are conductive carbon deposited on the insulative
3 layer.

1 23) The device of Claim 18, wherein the conductive leads and
2 conductive contacts are doped silicon conductive.

1 24) The device of Claim 18, wherein the silicon substrate is
2 sufficiently doped to form one of the pair of conductive leads and
3 one of the pair of conductive contacts.

1 25) The device of Claim 1, wherein the biosensor is an optical
2 biosensor, the signal is alterations in photon energy, the signal
3 carrier is an optrode; and the interface structure is an optical
4 coupler.

1 26) The device of Claim 1, wherein the biosensor is positioned
2 on the microprobe portion sufficiently distant from the body end to
3 pass into the subject during penetration.

1 27) The device of Claim 1, wherein the biosensor is positioned
2 on the microprobe portion near the penetration end.

1 28) The device of Claim 1, wherein the biosensor is on the
2 microprobe portion near the body end or on the body portion.

1 29) The device of Claim 28, further comprising an open fluid
2 channel formed in the microprobe portion between the penetration end
3 and the biosensor for transporting analyte fluid to the biosensor by
4 capillary action.

1 30) The device of Claim 29, wherein open fluid channel is a V-
2 groove etched in the silicon of the microprobe portion.

1 31) The device of Claim 1, wherein the surface of the side of
2 the silicon substrate is planar, and the biosensor is deposited onto
3 the planar surface.

1 32) The device of Claim 1, wherein the silicon substrate has a
2 cavity extending into the silicon substrate in the Z thickness
3 dimension, and the biosensor is deposited onto the silicon within the
4 cavity.

1 33) The device of Claim 1, wherein the silicon substrate has a
2 hole extending therethrough in the Z thickness dimension, and the
3 biosensor is deposited onto the silicon within the hole.

1 34) The device of Claim 1, further comprising multiple
2 biosensors integrated into either or both sides of the silicon
3 substrate.

1 35) The device of Claim 34, wherein each of the multiple
2 biosensors senses the presence of a different analyte.

1 36) The device of Claim 34, wherein each of the multiple
2 biosensors is positioned at a different location along the X
3 dimension of the microprobe to sense analyte presence at a different
4 penetration depth.

1 37) The device of Claim 1, wherein the silicon substrate is
2 formed of single crystal silicon.

1 38) An analyte monitoring assembly for emplacement on a subject
2 which provides a transmitted a signal to an external analyte meter
3 indicating analyte presence in an analyte-containing fluid of the
4 subject, comprising:

5
6 a base member having an in vivo face disposed toward the
7 subject when emplaced;

8
9 a silicon substrate member mounted on the base member having an
10 X length dimension generally normal to the in vivo face of the base
11 member;

12
13 a body portion formed by the silicon substrate member;

14
15 a signal transmitter on the body portion for providing the
16 transmitted signal;

17
18 a microprobe portion formed by the silicon substrate member on
19 the in vivo face of the base member, having a body end connected to
20 the body portion, and having a penetration end extending away from
21 the body portion in the X length dimension for penetrating into the
22 subject to access the analyte-containing fluid;

23
24 biosensor on the silicon substrate member for sensing analyte
25 presence and for providing a sensed signal in response to the analyte
26 presence; and

27
28 signal carrier deposited on the silicon substrate member
29 between biosensor and transmitter for carrying the sensed signal to
30 the transmitter.

1 39) The device of Claim 38, wherein the in vivo face of the
2 base member has a stabilizing surface for engaging the subject to
3 maintain the penetration orientation of the microprobe portion.

1 40) The device of Claim 39, further comprising an adhesive on
2 the stabilizing surface for retaining the assembly in place during
3 emplacement.

1 41) The device of Claim 39, wherein the stabilizing surface
2 limits the penetration of the microprobe portion into the subject.

1 42) The device of Claim 38, further comprising an analog to
2 digital converter for converting the sensed signal from the biosensor
3 into a digital transmitted signal.

1 43) The device of Claim 38, further comprising a power source
2 on the body portion for activating the signal transmitter.

1 44) The device of Claim 38, wherein the signal transmitter and
2 the power source are deposited into the silicon forming the body
3 portion of the silicon substrate.

1 45) The device of Claim 38, further comprising a cover member
2 over the body portion of the substrate and engaging the base member
3 for sealing the assembly.

1 46) The device of Claim 38, wherein the monitoring assembly is
2 emplaced for a single transmission.

1 47) The device of Claim 38, wherein the monitoring assembly is
2 emplaced for continuous transmission.